

Appl. No. 10/711,015
Amdt. dated February 14, 2006
Reply to Office action of November 16, 2005

Amendments to the Claims:

1. (Currently amended) A copper damascene process, comprising:
 - forming a dielectric layer overlying a substrate;
 - etching a damascene opening into said dielectric layer;
 - 5 filling said damascene opening with copper or copper alloy;
 - treating a surface of said copper or copper alloy with hydrogen-containing plasma;
 - reacting said treated surface of said copper or copper alloy ~~with trimethylsilane or~~
~~terramethylsilane~~—under plasma enhanced chemical vapor deposition (PECVD) conditions comprising simultaneously supplying trimethylsilane or terramethylsilane and
 - 10 initiating plasma to make said trimethylsilane or terramethylsilane react with said treated surface of said copper or copper alloy; and
 - in-situ depositing, by PECVD, a silicon carbide layer capping on said copper or copper alloy.
- 15 2. (Original) The copper damascene process according to claim 1 further comprising:
 - lining said damascene opening with a diffusion barrier layer;
 - forming a seed layer on said diffusion barrier layer; and
 - forming said copper or copper alloy on said seed layer.
- 20 3. (Original) The copper damascene process according to claim 1 wherein said damascene opening comprises a contact or via hole in communication with a trench opening.
4. (Original) The copper damascene process according to claim 1 wherein the step of
25 reacting said treated surface of said copper or copper alloy with trimethylsilane or terramethylsilane comprises following processing parameters: a trimethylsilane (or terramethylsilane) gas flow in the range of 100 to 5000 sccm; a process temperature in the range of 300°C to 450°C; and a reaction duration in the range of 0.1 seconds to 30

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seconds.

5. (Currently amended) A copper damascene process, comprising:
 - 5 forming a dielectric layer overlying a substrate;
 - etching a damascene opening into said dielectric layer;
 - filling said damascene opening with copper or copper alloy;
 - treating a surface of said copper or copper alloy with hydrogen-containing plasma;
 - reacting said treated surface of said copper or copper alloy with ~~trimethylsilane or tetramethylsilane~~—under plasma enhanced chemical vapor deposition (PECVD)
 - 10 conditions comprising simultaneously supplying trimethylsilane or tetramethylsilane and initiating plasma to make said trimethylsilane or tetramethylsilane react with said treated surface of said copper or copper alloy; and
 - 15 in-situ depositing, by PECVD, a silicon carbide layer capping on said copper or copper alloy, said silicon carbide layer being treated with in-situ ammonia plasma to remove contained oxygen of the deposited layer.
6. (Original) The copper damascene process according to claim 5 further comprising:
 - 20 lining said damascene opening with a diffusion barrier layer;
 - forming a seed layer on said diffusion barrier layer; and
 - forming said copper or copper alloy on said seed layer.
7. (Original) The copper damascene process according to claim 5 wherein said damascene opening comprises a contact or via hole in communication with a trench opening.
- 25 8. (Original) The copper damascene process according to claim 5 wherein the step of reacting said treated surface of said copper or copper alloy with trimethylsilane or tetramethylsilane comprises following processing parameters: a trimethylsilane (or

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terramethylsilane) gas flow in the range of 100 to 5000 sccm; a process temperature in the range of 300°C to 450°C; and a reaction duration in the range of 0.1 seconds to 30 seconds.

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